ORIGINAL ARTICLE

Malaria preventive behaviors among housewives in suburbs of Bandar-Abbas City, south of Iran: interventional design based on PRECEDE model

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ABSTRACT

Suburban areas suffer from unfavorable conditions as a result of poor health standards, low income, illness, and slight levels of education. One of the most important components in malaria elimination programs is health education. Bandar-Abbas is a malaria endemic city. Therefore, this study aimed to promote malaria preventive behaviors among housewives in suburbs of Bandar-Abbas City, Iran, through a PRECEDE model-based intervention program. This quasi-experimental study was carried out on 172 housewives under the coverage of four healthcare centers in Bandar-Abbas in 2016. The participants were randomly divided into two experimental and control groups, based on the inclusion criteria. The data collection tools included a demographic questionnaire, a researcher-made questionnaire based on the educational phase of the PRECEDE model and a checklist for assessing malaria preventive behaviors. After the pre-test, the educational intervention was implemented on the intervention group at the first stage and the same questionnaire was administered as the post-test for both groups two months after the intervention. In this study, after implementing the intervention using the PRECEDE educational program, a significant difference was found between the intervention and control groups in the mean scores for predisposing factors (knowledge and attitude) ($P < 0.001$), enabling factors ($P < 0.001$) and reinforcing factors ($P < 0.001$), which contributed to the improvement of preventive behaviors ($P < 0.001$). The PRECEDE model-based health education was effective in increasing knowledge and attitude, enabling and reinforcing factors, and promoting malaria preventive behaviors in the studied endemic areas.

KEYWORDS

Malaria; housewives; PRECEDE model; suburbs; health education; Iran

Introduction

Malaria is a global public health issue and a major parasitic disease which is widespread in tropical and subtropical regions [1]. According to the latest World Malaria report, nearly half of the world's population was at risk of malaria, and an estimated 216 million cases of malaria occurred worldwide; the estimated number of malaria deaths reached 445,000 in 2016, and one child died of malaria every 2 minutes [2]. Southeast Asia, the Eastern Mediterranean region, the Pacific Ocean and the United States were at high risk of malaria and 91 countries reported ongoing malaria transmission [2]. Islamic Republic of Iran, located in the Eastern Mediterranean region, has some areas with an annual parasite incidence (API) ranging from 0.14 to 8.74 per 1,000 people [3]. About 2,714,684 Iranian people are at risk of malaria which accounts for 9% of the total population of the country [4]. While less than 10.5% of the total population of Iran live in Hormozgan province, it is an endemic area and 38% of all malaria cases in Iran have occurred in this province [5,6].

Malaria causes birth weight loss, premature birth, abortion, stillbirth and mortality among children less than 5 years of age and pregnant women [7,8]. In order to reduce the incidence of malaria among pregnant women and children under the age of 5, the main interventions have focused on the control of malaria carriers through the use of insecticide-treated mosquito nets, malaria epidemic management and intermittent preventive treatment in pregnancy. Increase in the long-term use of insecticide-treated mosquito nets on a high scale has been among the expectations, and malaria elimination is one of the government priorities in Iran [5].

However, malaria elimination requires a combination of different factors including comprehensive knowledge, positive attitude, environmental management, stagnant water removal, mosquito nets, participation in malaria elimination programs and access to services. Improved understanding of malaria transmission can greatly contribute to malaria prevention and control [9]. Once effective interventions are thoroughly implemented, malaria could thus become preventable and curable [10,11].

Health education is an important component of malaria control programs [12]; on the other hand, prevention strategy and behavior change require the use of educational models [13]. The PRECEDE model is a planning and educational model developed in the 1980s [14]. This is based on epidemiologic, social, behavioral, administrative and educational sciences which incorporate behavioral and environmental factors that influence personal health activities. Additionally, it can help health program planners achieve their goals through designing interventions and contributing to the compilation and evaluation of educational programs [15].

‘PRECEDE’ (i.e. Predisposing, Reinforcing and Enabling Constructs in Education and Environmental Diagnosis and Evaluation) is a theoretical model to determine health promotion and education needs [16]. This model identifies a clear framework of the factors influencing behavior, such as predisposing factors (awareness, attitude, etc.), reinforcing factors (the effect of family members, peers, etc.), and enabling factors (availability of skills and resources) in an educational program [17]. The focus of this model is on behavioral change. Given the rising healthcare needs, limited resources, and ascending community expectations, this model is a systematic planning process applied to all health issues which contribute to the development of the most effective interventions [18].

The United Nations’ International Conference on Population and Development considered women’s education as the only important factor leading to a significant improvement in their health. Given that women take care of other family members, the target audience for malaria intervention programs are women (to ensure better healthcare access) [19]. Suburban residents suffer from unfavorable conditions due to poor health, increasing poverty, low educational levels, negligible income due to illness, excessive costs of healthcare, and use of urban facilities and services [20].

Malaria is, however, still a serious health issue particularly in Hormozgan, Sistan-Baluchistan and Kerman provinces of southeast Iran [21]. Unstable hypo-endemic malaria is observed in Bandar-Abbas City of Hormozgan province and there is always a malaria epidemic risk following torrential precipitation and conditions that allow for *Anopheles* mosquitoes’ breeding, as well as the existence of many immigrants in this city [22]. Since Bandar-Abbas is a malaria-endemic city and due to a lack of female suburban access to healthcare services and health education negligence as an important component of the malaria control program, the present study aimed to promote malaria preventive behaviors among housewives registered in Bandar-Abbas health centers through a PRECEDE model-based intervention program.

Materials and methods

Study area

The capital city of Bandar-Abbas, Hormozgan province, Iran, lies on the northern seashore of Persian Gulf. Its geographic coordinates are 56°17'E, 27°13'N, with an altitude of about 20 m above sea level. Its maximum and minimum temperatures are 52°C and 2°C, respectively. Its relative humidity is more than 60%. Its mean annual precipitation rate amounts to 200 mm. Its population was 526,648 in 2016 census.

Study design

This was a quasi-experimental study with before and after intervention design and a control group. Out of 11 healthcare centers in Bandar-Abbas, the capital city of Hormozgan province, four were selected randomly. Two centers were selected as the control group (Khalij-Fars Community and 22-Bahman healthcare centers) and two as the intervention group (Chahestani and Shahed), using random sampling method.

Sample allocations

In a recent study, some statistics found the least difference in the mean scores for attitude between the experimental and control groups which were $\mu_1 = 24.4$ $\sigma = 1.77$, $\mu_2 = 23.3$ $\sigma = 2.44$, and $\alpha = 0.50$; the power was 1- β 90 after education [23]. At least 86 individuals were allocated to each group from each center.

Of the 400 housewives under the coverage of each healthcare center, 86 were allocated to the control group and 86 subjects to the intervention group using a systematic random sampling method. Based on the Census Data Sheets, 400 were divided by 43 and the approximate distance between households was 10. The first household was selected as No. 1, the second one No. 10, the third one No. 20 and this went on until the sample size reached 43 from each center.

Ethics

In the sample selection, geographical dispersion and lack of communication between the two groups were taken into consideration. To observe ethical principles, the study aim was explained to the subjects, confidentiality of the information was emphasized, and informed consent was obtained before completing the questionnaires. After implementing the intervention and collecting the data, the educational intervention was also implemented for the control group.

Inclusion-exclusion criteria

The inclusion criteria were married housewives aged over 15 years under the coverage of the healthcare center who were continuously interested in the educational program and successively attended it. The exclusion criteria were lack of cooperation, absence from the educational program for more than one session, and lack of pre-test or post-test attendance.

Study tools

The instrument used in this study included a valid questionnaire comprising 8 demographic questions, a checklist of malaria preventive behaviors with 7 questions (existence of pits, ponds and waste around house, use of door and window screens, and bed nets), a researcher-made questionnaire based on the PRECEDE educational phase with 14 knowledge questions (ways of disease transmission, symptoms, groups 'at risk', mosquito growth environments, ways to diagnose malaria, prevention methods, etc.), 8 attitude questions (I am afraid of getting malaria, it is difficult to use mosquito nets, house spraying has no effect on malaria prevention, I think I won't get malaria if I drain stagnant water away from my house, etc.), 9 reinforcing questions (Do your spouse, children, friends, etc. encourage and help you take malaria preventive measures) and 9 enabling questions (mosquito nets' distribution sites, holding educational classes, house spraying, malaria sampling centers, etc.).

Attitude and knowledge sub-scales were used to assess the predisposing factors. To assess knowledge, a score of 2 was assigned to each correct answer and a score of 1 to each wrong answer. Therefore, the range of the scores obtained was 14–28. The 3-point Likert scale (I agree = 2, I have no idea = 1 and I disagree = 0) was used to measure attitude. To measure the enabling and reinforcing factors, 3 options were used (yes = 2, somewhat = 1 and no = 0). A checklist was used to assess the behavior. The data collection tool was designed using a researcher-made questionnaire based on the PRECEDE educational model.

Validity, reliability and intervention

The validity of the questionnaire was evaluated using the views of a malaria specialist and experts experienced in the field of health promotion and education. The relevance, reliability and appropriateness of questions, the existence of ambiguities, possible inadequate understanding of the questions and the level of difficulty in understanding the concepts were taken into account. The test-retest method was used to determine the scientific reliability of the knowledge scale. The test-retest was administered and completed by 40

participants (housewives) twice at a 2-week interval (14 days). The total correlation coefficient was 92%, the consistency coefficient of attitude scales was obtained 89%, reinforcing factors 90%, enabling factors 87% and the consistency coefficient of behavior was 84%. The educational program used in this research project was part of the National Malaria Elimination Plan and the pre-test results for the target population were obtained through evaluation of the PRECEDE model scales. The educational intervention was conducted once a week for 5 weeks. Each educational session lasted for 40–60 minutes. Group discussion, lecture, and question and answer methods were used in five educational sessions for the intervention group. The intervention group was divided into four sub-groups for each educational session that was held every week. A trusted friend or family member accompanied each housewife in the sessions to support and encourage the use of mosquito net and other malaria prevention devices. At the end of the sessions, the participants were provided with educational pamphlets on malaria (definition of malaria, its significance, its repository and symptoms, its transmission and treatment modes, the relationship between the disease and stagnant water, proper prevention methods, proper use of mosquito nets and installing mesh screens). The questionnaires and the checklist of malaria preventive behaviors were completed after two months and the pre- and post-test results were compared.

Data analysis

In this study, data analysis was conducted through SPSS software version 20, using independent samples *t*, paired *t* test, chi-squared test, analysis of variance (ANOVA) and Wilcoxon signed rank test. A *P*-value of less than 0.05 was taken as the statistically significant difference.

Results

General and demographic characteristics such as age, family size, education, history of malaria, etc. are shown in Table 1. There was no statistically significant difference between the two control and intervention groups. Therefore, before the intervention, the two groups were similar in terms of descriptive variables.

Regarding malaria information resources, 45.3% of the subjects had obtained their information from radio and television, 10.46% through reading books and magazines and 17.44% from health staff, 17.44% from friends and relatives, and 9.30% had no information on malaria.

Table 2 compares the intervention and control groups in terms of knowledge, attitude, and practice (KAP), and reinforcing and enabling factors. Before the health education intervention, no significant difference

Table 1. General characteristics of the participants in the intervention and control groups in Bandar- Abbas, 2016.

Variables		Intervention group	Control group	Pa
Age, y; mean $\pm$ SD		30.27 $\pm$ 8.05	30.57 $\pm$ 8.32	0.89
Family size; mean $\pm$ SD		3.97 $\pm$ 1.70	3.74 $\pm$ 1.40	0.23
Educational level; No. (%)				
	Diploma or lower	53 (61/7)	55(64)	0.921
	College or higher	33(38/3)	31(36)	
History of malaria; No. (%)				
	Yes	28(32.55)	32(37.20)	0.412
	No	58(67.44)	54(62.79)	
Income, Riyal; No. (%)				
	< 5,000,000	47(54.65)	45(52.32)	0.821
	<5,000,000 > 10,000,000	32(37.22)	34(39.55)	
	> 10,000,000	7(8.13)	7(8.13)	
Education on malaria to date; No. (%)				
	Yes	21(24.41)	21(24.41)	1.000
	No	65(75.58)	65(75.58)	
Heard the name of malaria; No. (%)				
	Yes	82(95.34)	85(98.83)	0.140
	No	4(4.66)	1(1.17)	

a $P < 0.05$ **Table 2.** Comparison of the two groups' mean scores of the constructs of PRECEDE model and malaria preventive behaviors before and after the intervention in Bandar Abbas, 2016.

Variables	Group	Before the intervention (Mean $\pm$ SD)	After the intervention (Mean $\pm$ SD)	Pa
Knowledge	Intervention	20.81 $\pm$ 3.65	25.58 $\pm$ 2.48	<0.001 ^a
	Control	20.48 $\pm$ 3.65	19.21 $\pm$ 3.03	0.345
Attitude	Intervention	10.91 $\pm$ 2.8	12.50 $\pm$ 2.16	<0.001 ^a
	Control	9.42 $\pm$ 3.35	9.76 $\pm$ 2.54	0.273
Practice	Intervention	10.91 $\pm$ 2.89	12.50 $\pm$ 2.78	<0.001 ^a
	Control	7.51 $\pm$ 2.78	7.36 $\pm$ 2.75	0.657
Reinforcing factors	Intervention	7.00 $\pm$ 2.9	10.91 $\pm$ 2.1	<0.001 ^a
	Control	8.90 $\pm$ 4.45	8.67 $\pm$ 4.45	0.642
Enabling factors	Intervention	5.82 $\pm$ 3.56	11.87 $\pm$ 4.10	<0.001 ^a
	Control	5.57 $\pm$ 3.70	5.55 $\pm$ 3.65	0.929

a $P < 0.05$

was found between the two groups in knowledge, attitude, performance, and enabling and reinforcing factors' scores. After the educational intervention, these scores were, however, significantly higher in the intervention group compared to those in the control group ($P < 0.001$). Enabling factors presented the highest, whereas attitude showed the lowest difference in these scores.

Table 3 shows the comparison of the frequency distribution of different constructs of malaria preventive behaviors in the two intervention and control groups both before and after the intervention among housewives in Bandar-Abbas, in 2016. All except roofed abandoned places exhibit significant differences between the intervention and the control groups. Bed net usage revealed the highest difference in the scores between pre- and post-education intervention compared with the control group.

Discussion

In developing countries, control and elimination of vector-borne diseases as well as improved maternal reproductive, children and family health have been emphasized [24]. One of the main malaria elimination program strategies is protecting 80% of children and

pregnant women at risk of malaria by appropriate preventive measures such as insecticide-treated bed nets, spraying (if necessary), early and timely diagnosis and treatment, health education, communication programs for health promotion, detection of high-risk behaviors, and demand for goods or services among family members [25,26]. This health education interventional trial based on a PRECEDE model exhibited the efficacy of various subjective (Table 2) and objective (Table 3) parameters on the behaviors of housewives in the suburbs of Bandar-Abbas city, south Iran, in 2016. This study led to promotion of malaria preventive behaviors among housewives through the PRECEDE model-based intervention program.

There were significant differences between the two control and intervention groups in the mean scores of predisposing factors (knowledge and attitude), enabling and reinforcing factors and preventive behaviors promotion following educational intervention in this study. This was consistent with previous research on the elderly [27] and cutaneous leishmaniasis [28]. Knowledge and practice on malaria were cues to implementation of appropriate, long-lasting and effective interventions, while no interventional study has been conducted on malaria using the PRECEDE model in Iran. Variable health-related behavior necessitates learning

Table 3. Comparison of the frequency distribution of the constructs of malaria preventive behaviors in the two groups before and after the intervention in Bandar-Abbas, 2016.

Variables		Intervention group			Control group	
			N (%)	Pa	N (%)	Pa
Pits and ponds exist	Before	Yes	52(60.5)	<0.001a	60(69.8)	0.371
		No	34(39.5)		26(30.2)	
	After	Yes	25(29.1)		61(70.9)	
		No	61(70.9)		25(29.1)	
Trash presence	Before	Yes	56(65.1)	<0.001a	60(69.8)	0.310
		No	30(34.9)		26(30.2)	
	After	Yes	36(41.9)		61(70.9)	
		No	50(58.1)		25(29.1)	
Bed net usage	Before	Yes	26(30.2)	<0.001a	31(36)	1.000
		No	60(69.8)		55(64)	
	After	Yes	56(65.1)		31(36)	
		No	30(34.9)		55(64)	
Bed net incomplete	Before	Yes	50(58.1)	<0.001a	52(60.5)	0.311
		No	36(41.9)		34(39.5)	
	After	Yes	25(29.1)		53(61.6)	
		No	61(70.9)		33(38.4)	
*D/W screen usage	Before	Yes	37(43)	<0.001a	28(67.4)	0.310
		No	49(57)		58(32.6)	
	After	Yes	56(65.1)		30(34.9)	
		No	30(34.9)		56(65.1)	
*D/W screen incomplete	Before	Yes	61(70.9)	<0.001a	53(61.6)	0.310
		No	25(29.1)		33(38.4)	
	After	Yes	34(39.5)		56(65.1)	
		No	52(60.5)		30(34.9)	
Roofed abandoned places	Before	Yes	37(43.1)	0.19	36(41.8)	0.310
		No	49(56.9)		50(58.2)	
	After	Yes	33(38.4)		34(39.5)	
		No	53(61.6)		52(60.5)	

a $P < 0.05$; D/W: door/window

health facts [17]. Housewives' knowledge was, thus, considered as one of the predisposing factors, and the mean scores for knowledge increased significantly in the intervention group following education. This was in agreement with the results of the studies conducted in northeastern Ethiopia [29], Rwanda [11], and Colombia [30] on malaria as well as interventional studies based on the PRECEDE model on heart disease [31] and coronary artery disease [32]. In the current study, the highest and lowest scores in knowledge belonged to general signs and prevention or transmission routes of malaria disease, respectively. Educational intervention, which actively affects people's perception and knowledge development, has an important role in the success and maintenance of malaria elimination strategies [6].

Health behaviors are largely dependent on personal attitudes towards oneself and one's health as well as health and societal values that one adheres to. Housewives' attitude was also considered as the second predisposing factor; however, after the educational intervention, the mean scores changed in both control and intervention groups with the lowest difference among all constructs. These results were in line with those of previous reports from northern Nigerian state [33] and China [34] on the attitude toward malaria without applying the PRECEDE model, and coronary artery disease [32], elderly [35] and cutaneous leishmaniasis (CL) after using the PRECEDE model [28]. This can be explained by developing the families' perception on regular use

of bed nets, its advantages and probably establishing positive attitudes.

Enabling factors included access to sampling centers and bed nets (one of the main components of malaria elimination programs), holding educational sessions and improving the skills needed to use bed nets. The highest significant difference in the score of the intervention group was observed after the intervention, which was in accordance with the research conducted on iron deficiency anemia group [15] and coronary artery bypass graft patients [16]. This finding was in sharp contrast to that on epilepsy patients in Tehran, Iran [36]. Qualitative knowledge about malaria transmission routes, advantages of preventive measures and the accessibility of these devices to families and communities can assist effective strategies in malaria eliminations program, particularly the use of bed nets [37].

Reinforcing factors comprised encouragement and support from family members, peers, friends, associates and trusted individuals (often their spouses, mothers) since these individuals encouraged preventive behavior and provided ongoing rewards to continue the behaviour. There was a significant difference between the intervention and the control groups after the health education, which was in agreement with previous studies on the patients' coronary artery disease [32], CL [28] and immigrant groups [5]. The implementation of reinforcing factors can culminate in change of behavior and acquisition of permanent rewards to maintain it.

There was no significant difference in only one of the items (roofed abandoned places) in the checklist of malaria preventive behaviors between the intervention and control groups after the health education. This lack of change in the intervention group may be due to poverty or excessive financial resources required to demolish abandoned roofed places and the eroded foundation of suburban areas. These results were also in line with those in Kerman, Iran [23] and Chiang Mai Province, Thailand [38]. In other items, there were significant differences between the intervention and control groups after the health education. The rate of mosquito net use before the intervention was lower than 80%. The reason for this low rate is probably scant awareness of the disease and negative attitudes towards mosquito nets. This rate of mosquito net use was less than that in other malaria-endemic countries like Sierra Leone (67.2%), India (79.2%), and Sri Lanka (90%) [39–41]. The reason for the effectiveness of using mosquito net was probably creating a positive attitude towards the use of preventive devices, especially mosquito nets.

The strength of the present study was that significant practical and theoretical changes were observed in most of the variables in the checklist of malaria preventive behaviors after 5 educational sessions. Effective steps could be undertaken towards malaria prevention and elimination using health education strategies based on appropriate models and theories as well as supporting and empowering individuals and communities. Among the limitations of this study were the participants' low educational levels in the suburban areas. Cultural disparities and discrepancies in attitudes among housewives were also the two other pitfalls which were attempted to be minimized in group discussions. Another limitation in the present study was the implementation of locally developed facilities to combat malaria which could not be extrapolated to cover studies in other regions. There was no similar study on the use of PRECEDE towards malaria elimination programs. A major endeavor to eliminate malaria needs to be undertaken by health practitioners to achieve its goal in Iran [42]. It is suggested that further studies need to be conducted to fulfill the gaps of knowledge related to health education leading to malaria elimination goals in south Iran.

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